Anterior Approach for Posteromedial Tibial Plateau Fractures

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Fractures of the posteromedial tibial plateau are rare and their treatment is not well established. Between January 2004 and December 2008, eight patients with fractures of the posteromedial tibia plateau were identified. All patients were treated with fracture reduction using an anterior approach. After a mean follow-up of 21 months, the average range of knee motion was 0–123° of flexion. Seven patients had been injured in motor-scooter accidents, in which the protective front plate of the scooter had hit the knee while it was in the 90°-flexion position. At the final follow-up, 87.5% (7/8) patients had satisfactory reductions of the articular surface, and all patients had acceptable alignments. There were no neural or vascular injuries following surgery, and no superficial or deep infections. The average Hospital for Special Surgery Knee Score was 89. In conclusion, fracture reduction using the anterior approach is associated with fewer complications than the posterior approach, and good functional recovery can be expected.

Key Words: anterior approach, tibial plateau fracture
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Tibial plateau fractures involving the posteromedial fragments are uncommon injuries and are rarely reported in the literature [1,2]. There are several reports on the use of direct fracture reduction using the posterior approach. However, a high rate of complications has been associated with this procedure, including saphenous nerve paresthesia, deep vein thrombosis, extension lag, and flexion lag [1,2]. In this study, we present a case series of posteromedial tibial plateau fractures treated using an anterior approach, with an evaluation of the functional results.

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Patients and Methods

Between January 2004 and December 2008, 230 patients with tibial plateau fractures were operated at our institution. Of these, eight patients (3%) had closed posteromedial tibial plateau fractures. The subjects included four women and four men, and the average age at the time of injury was 32 years. The fractures involved six left knees and two right knees. The patient demographics are shown in the Table. Preoperative evaluation included anteroposterior and lateral radiography, and computed tomography (Figure). All fractures were treated operatively using an anterior approach.

Under general anesthesia, each patient was placed in the supine position with a pneumatic tourniquet around the thigh. Antibiotic prophylaxis with a cephalosporin antibiotic was administered to all patients.

Table. Patient details including clinical and radiological results

Case	Age (yr)/sex	Mechanism	Duration (d)*	AO/OTA classification	Method of fixation	Follow-up (mo)	Range of motion (E–F)	HSS score	Bony union (wk)	Radiological results		
										Articular step-off (mm)	Coronal alignment	Sagittal alignment
1	39/M	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	25	0–130	95	12	0	87°	6°
2	31/F	Fall from height	2	41-B1.2(4)	Cancellous screws	25	0–125	95	12	0	88°	5°
3	39/M	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	24	0–110	85	12	0	90°	7°
4	24/M	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	24	0–130	84	10	0	84°	9°
5	45/F	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	24	0–125	85	12	0	86°	6°
6	28/M	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	18	0–120	90	12	0	85°	7°
7	21/F	Motor-scooter accident	1	41-B1.2(4)	Cancellous screws	16	0–125	88	12	2	84°	10°
8	30/F	Motor-scooter accident	4	41-B1.2(4)	Cancellous screws	12	0–120	90	10	4	88°	11°

*Time from injury to surgery. M = male; F = female; E–F = extension to flexion; HSS = hospital for special surgery knee.

An anteromedial incision was made and extended distally below the inferior margin of the fracture site. Using fluoroscopic guidance, the articular surfaces were reduced with the knee fully extended or slightly hyperextended. Multiple Kirschner wires were inserted from the posteromedial popliteal fossa for temporary fixation of the fragments. Cancellous screws were applied, and the fascia and skin were closed over the suction drains.

A posterior plaster splint was applied postoperatively. Physical therapy was prescribed, with emphasis on muscle strengthening exercises. No weight bearing was permitted for 8 weeks after surgery. Regular radiographic images were obtained after the operation, at a frequency of once every 4 weeks until the fracture healed, and subsequently once a year. The quality of fracture reduction was evaluated on the basis of three radiographic parameters: articular reduction, coronal alignment and sagittal alignment. Fracture reduction was satisfactory if the articular step-off was <2 mm, the medial proximal tibial angle was $87° \pm 5°$, and the posterior proximal tibial angle was $9° \pm 5°$ [3]. Measurement of the range of motion of each patient's knee was performed at the final follow-up visit, and all patients were evaluated using the Hospital for Special Surgery Knee scoring system [4].

Results

Of the eight patients, seven had obtained the injury in motor-scooter accidents, and one after falling from a height. The mean time from injury to surgery was 1.5 days (range, 1–4 days), and the average duration of follow-up was 21 months (range, 12–25 months). Bony union occurred at a mean of 11.5 weeks (range, 10–12 weeks) after surgery. The stability of the knee joint was assessed after osseous anatomy was restored, and no ligamentous ruptures were observed. All the fractures were located on the posteromedial tibial plateau. According to the AO/OTA classification system [5], all eight patients had split fractures and were classified as 41-B1.2(4).

At the final follow-up, the average range of knee motion was 0–123° of flexion. Seven patients had satisfactory articular reduction (≤2-mm step or gap). The reduction was classed as imperfect in one patient. The mean medial proximal tibial angle in this patient was 86° and the mean posterior proximal tibial angle

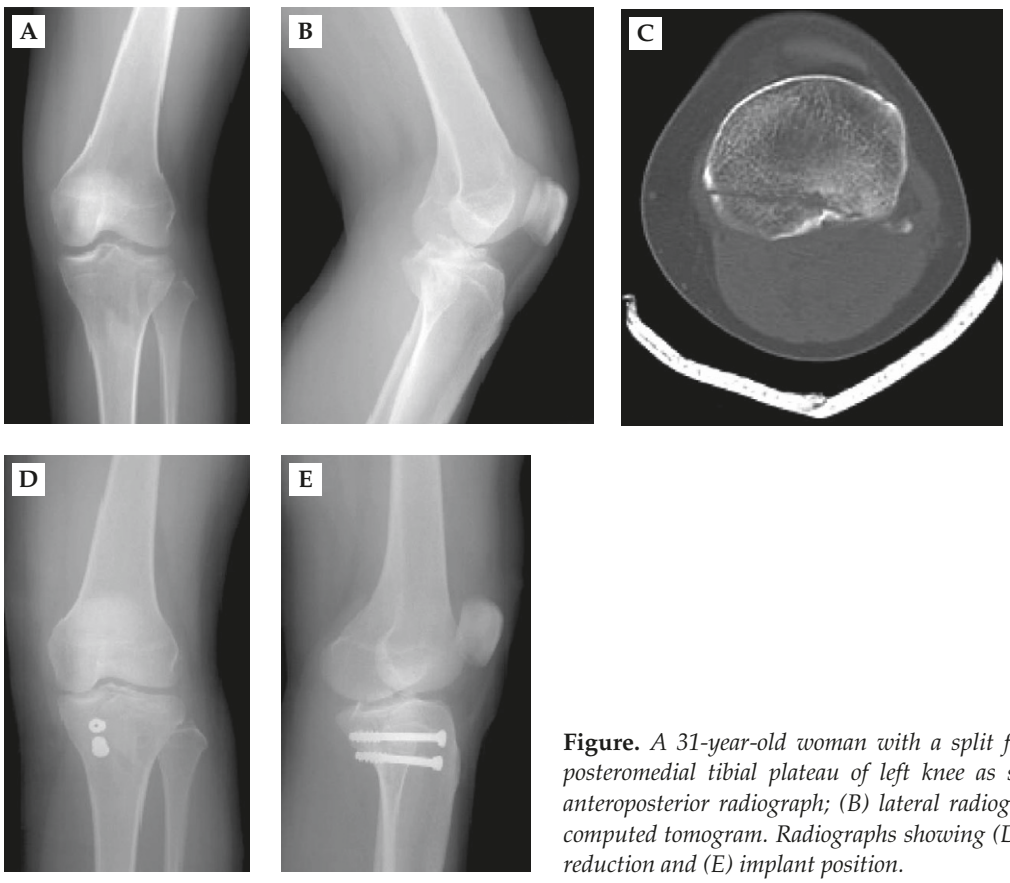

Figure. *A 31-year-old woman with a split fracture of the posteromedial tibial plateau of left knee as shown in (A) anteroposterior radiograph; (B) lateral radiograph; and (C) computed tomogram. Radiographs showing (D) the fracture reduction and (E) implant position.*

was 7°. All patients had satisfactory sagittal and coronal alignments. None of the patients sustained neural or vascular injuries. There were no cases of nonunion, loss of reduction, or wound complications. There was no joint-space narrowing of the knee (indicating posttraumatic arthritis) in any of the patients at the final follow-up. The average Hospital for Special Surgery Knee Score was 89 (range, 84–95) [4].

Discussion

Posteromedial tibial plateau fractures are uncommon injuries and are not frequently reported. This specific fracture pattern is not well described by the Schatzker classification system [6]. Hohl [7] classified tibial plateau fractures into six groups: undisplaced, central depression, split depression, total depression, split, and comminuted upper end of the tibia. Split fractures involve anterior or posterior condylar margins. Moore [8] described a radiographic classification of fracture-dislocations of the knee that included five types: split, entire condyle, rim avulsion, rim compression, and four-part. The split type occurs in the coronal place instead of the sagittal plane, which represents the posterior fragment of the medial condyle. The AO/OTA classification system [5,9] classifies posteromedial tibial plateau fractures as partial articular (41-B), with the addition of a sixth number in parentheses to depict the posterior articular surface in a comprehensive way. For example, 41-B1.2(4) is used to designate a partial articular split fracture of the proximal tibial medial surface on the posterior aspect of the frontal plane. 41-B2.3(3) includes proximal tibial partial articular depression fractures of the medial plateau on the posterior aspect, 41-B3.2(2) includes proximal tibial partial articular split-depression fractures of the medial plateau on the posterolateral part, and 41-B3.2(4) includes proximal tibial partial articular split-depression fracture of the medial plateau on the posteromedial aspect.

Fractures in this area are difficult to detect on anteroposterior and lateral radiographs [10]. Computed tomography is useful for surgical planning and to determine the extent of the posteromedial tibial plateau fracture. The most common cause of this

type of fracture in the current study was motor-scooter accidents (87%, 7/8 patients). These patients were injured in traffic accidents, riding scooters on busy urban roads. Motor scooters are light motorcycles that have a protective front plate and support for the rider's feet. It is a very popular type of personal transportation in Kaohsiung. When riding a scooter, the driver sits with their knees flexed at an angle of >90°. If an accident occurs, the protective front plate of the scooter may hit the knee while it is in the flexed position, and the axial compression forces result in fracture of the posteromedial tibial plateau.

There are rare reports in the literature that specifically discuss the treatment of posteromedial tibial plateau fractures [1,2]. Some authors have described the use of the posterior approach for the treatment of the posterior aspect of tibial plateau fractures [1,2,11–14]. The posterior approach allows direct exposure of the fracture, fracture reduction under visualization, and buttress plate fixation. However, high rates of complications have been noted with this technique. The common peroneal nerve at the posterior aspect of the biceps femoris muscle, the popliteal vessels, the saphenous nerve at the posterior aspect of the medial plateau, the medial sural cutaneous nerve, and the tibial nerve in the popliteal fossa can be damaged during direct exposure of the fractures by the posterior approach. Georgiadis [2] reported the use of a posterior plate to fix the posteromedial fragments in four patients. Two of these developed transient paresthesia of the saphenous nerve, and two had extension lags of 5°. De Boeck and Opdecam [1] described seven patients with posteromedial tibial plateau fractures treated by a single posterior approach. The average extension lag was 7°, and the average flexion lag was 18°. One patient developed deep vein thrombosis. Carlson [12] reported the use of the direct posterior approach through dual incisions in five patients with posterior bicondylar tibial plateau fractures. One patient developed deep vein thrombosis and superficial wound dehiscence, and three patients had transient saphenous nerve sensory deficits. Tao et al [14] reported use of a modified posterolateral approach. In their study, 5/11 patients had 5° of flexion contracture, and one patient had a sanguineous effusion. Chang et al [13] reported eight cases with posterior coronal fractures of the lateral tibial plateau. These patients were treated by a posterolateral approach. Of these eight patients, four had a flexion lag ranging from 10–20°, and one developed peroneal nerve paresthesia. There were no neural or vascular injuries in our study, and none of the patients sustained flexion contracture of the knee. The anterior approach can thus be used to prevent the complications of neurovascular injuries and flexion contractures that are commonly associated with the posterior approach. Although it is difficult to achieve direct reduction of the posterior fragments using the anterior approach, good reduction can be accomplished by extension or hyperextension of the knee and the aid of fluoroscopy. In our study, the articular reduction was satisfactory (<2 mm step-off) in seven patients and imperfect (>2 mm step-off) in one. In the patient with imperfect reduction, full weight-bearing was noted at 4 weeks, which was earlier than recommended, and a 4-mm step-off was recorded later.

In conclusion, fracture of the posteromedial tibial plateau is caused by an axial compression force when the knee is in a flexed position, such as occurs in the event of a motor-scooter accident. The anterior approach can be used to prevent the complications of neurovascular injuries and flexion contractures that are commonly associated with the posterior approach. With careful preoperative planning, good functional results and recovery can be expected.

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以經前側探查手術來治療後內側脛骨平台骨折

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後內側脛骨平台骨折是一種不尋常的傷害，其治療方式還未有定論。自 2004 年 4 月至 2008 年 12 月發現 8 位病患為後內側脛骨平台骨折，全部的病患都接受經前側探查手術。平均追蹤期間為 21 個月，平均膝關節活動角度為 0 度至 123 度。其中有 7 位病患是因騎乘輕型機車車禍受傷，車禍發生時機車的保護前檔板撞擊彎曲成 90 度的膝部。在最後追蹤中，全部 8 位有 7 位 (比例 88%) 達到滿意的關節面復位，而全部的病患都達到令人滿意的膝部外型。手術後沒有發生神經或血管的損傷，也沒有發生淺層或深層的傷口感染。平均 Hospital for Special Surgery knee 評分是 89 分。結論：經前側探查的手術方式可以避免經後側探查手術發生的併發症，因此良好的功能恢復是可以期待的。

關鍵詞：經前側探查手術，脛骨平台骨折

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